

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
25 March 2004 (25.03.2004)

PCT

(10) International Publication Number  
**WO 2004/025362 A1**

(51) International Patent Classification<sup>7</sup>: **G02F 1/225,**  
1/035

Olevano Di Lomellina (IT). **PENSA, Simone** [IT/IT]; Via  
Cesare Battisti, 1, I-13030 Albano Vercelles (IT).

(21) International Application Number:  
PCT/EP2003/010093

(74) Agent: **MCGOWAN, Cathrine**; D Young & Co, 21 New  
Fetter Lane, London EC4A 1DA (GB).

(22) International Filing Date:  
9 September 2003 (09.09.2003)

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU,  
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,  
CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE,  
GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR,  
KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK,  
MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT,  
RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR,  
TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
02078774.3 13 September 2002 (13.09.2002) EP  
03075716.5 12 March 2003 (12.03.2003) EP

(71) Applicant (*for all designated States except US*): **AVANEX  
CORPORATION** [US/US]; 40919 Encyclopedia Circle,  
Fremont, CA 94538 (US).

(84) Designated States (*regional*): ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),  
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,  
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,  
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,  
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(72) Inventors; and

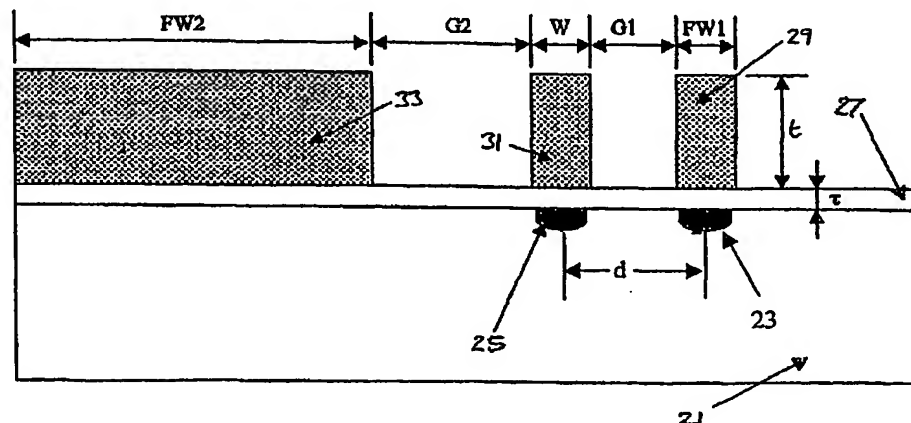
(75) Inventors/Applicants (*for US only*): **GILARDI, Gio-  
vanni** [IT/IT]; Via Santa Maria 21, I-23854 Olginate (IT).  
**MILANESE, Paolo** [IT/IT]; Via San Martino, 2, I-27020

Published:

— with international search report

[Continued on next page]

(54) Title: LITHIUM NIOBATE OPTICAL MODULATOR



(57) Abstract: An optical modulator comprises a Z-cut lithium niobate substrate (21) on which is formed a Mach-Zehnder interferometer having two generally parallel waveguides (23, 25) lying beneath a buffer layer of dielectric material (27). First and second ground electrodes (29, 33) and a hot electrode (31) are disposed on the buffer layer (27), the first and second ground electrodes (29, 33) being spaced either side of the hot electrode (31), the hot electrode (31) and the first ground electrode (29) being proximate to at least a part of the respective waveguides (25, 23). The electrode structure is unsymmetrical in that (a) the hot electrode and the first ground electrode each have a width substantially less than that of the second ground electrode and/or (b) the spacing between the first ground and hot electrodes is different from the spacing between the second ground and hot electrodes. whereby a range of chirp values can be obtained. When the spacing (G1) between the first ground and hot electrodes (29, 31) is smaller than the spacing (G2) between the second ground and hot electrodes (33, 31), and preferably the hot and first ground electrodes have a width not exceeding 15µm, the modulator is capable of operation at frequencies above 10GHz, possibly up to around 40GHz.



— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*